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ABSTRACT

This manual provides teachers with some knowledge of ecological study methods and techniques used in collecting data when plants and animals are studied in the field. Most activities deal with the interrelatedness of plant and animal life to the structure and characteristics of a stream and pond. Also included in this unit plan designed for the sixth grade level are suggestions for classroom and field organization, equipment required, and methods of approaching the major topics - mapping, animal life, plant life, the soil, and the water itself. Reference materials audio-visual aids, and supplemental activities are noted. (BL)

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STREAM STUDIES

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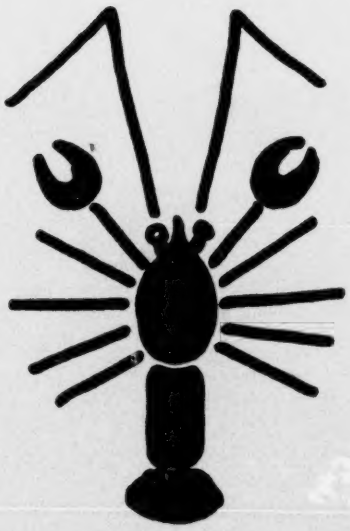

SE 010 746

The Board of Education for the City of Hamilton
Hamilton, Ontario

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THE STREAM AND POND COMMUNITY

I INTRODUCTION

This is a PIJI Unit recommended for study in Year Six. A shallow pond or wadable stream makes a safe starting point to investigate the interrelatedness (ecology) of the plant and animal life to the structure and characteristics of the stream itself. It is essential that the pupils be given the opportunity to work in an actual pond or stream as often as possible during this unit but much time can also be spent in the classroom getting ready and later working with the data collected.

This manual was prepared to assist teachers by providing some knowledge of ecological study methods and techniques used in collecting data when plants and animals are studied in the field. Presented also are some suggestions for pupil activities, classroom organization and equipment. This booklet is not a course of study and is intended to be used only as teacher reference material, should this topic be undertaken. The teacher should feel free to select only certain of the activities, modify the activities or to proceed entirely along independent lines while pursuing this topic.

NOTE: It should be most strongly impressed upon the pupils that the purpose of their visit is not to bring back to the classroom samples of everything that they can find. Their purpose is to visit the stream or pond in order to collect information from which conclusions about the life found there can be drawn. It requires but little imagination to perceive how quickly a stream or pond area could be denuded of both plant and animal life under successive waves of highly organized and determined pupil scavengers.

EQUIPMENT

The specific equipment needed will depend upon the activities selected by the pupils. Generally speaking the following will be useful.

Nets: These can be improvised from kitchen sieves and strainers, cheesecloth and coat hangers. Minnow trays and fine mesh siene nets can also be used.

Containers: Plastic pill vials, baby food jars and plastic bags which can be labelled are excellent for transporting specimens. A plastic pail and aluminum pie plate are useful for examining specimens before releasing them.

Measuring Devices: Ropes or poles marked at regular intervals, tapes and yardsticks will be required for mapping and measuring. Thermometers and watches may be required.

Data Sheets: Simple clipboards of thin plywood or masonite with an elastic to hold the data sheets on which the information can be jotted down as it is collected will help to save time while working at the stream site.

The pupils should have an opportunity to plan what they will do and decide what they will need. They could bring as many tools and materials from home as possible and be given time to construct their apparatus during the period allotted for science lessons. Some opportunity should be given to the pupils to practice using their newly manufactured equipment in order to refine both the apparatus itself and the techniques required for its use.

METHODOLOGY

The approach to this topic will undoubtedly depend upon the number of visits to an actual stream which can be arranged. For most classes this will unfortunately be a maximum of once in a school year. Three or more trips spaced about one week apart would be ideal. In any case the teacher should modify the approach which follows so that it conforms to his own situation.

It is probably wise to take the pupils on a tour of the stream as an introduction to this topic. During this first visit the pupils should be allowed to browse around, explore the general area and to find what is there that they might study. From time to time the teacher might assemble the class so that the pupils can ask questions and the teacher can focus the pupils' attention on the less obvious aspects which might otherwise be overlooked. The pupils might select the best location for their study, take photographs or make rough sketches for future reference during this preliminary excursion. Upon completion of this first visit the pupils could return to the classroom where planning and other organizational details could then be carried out much more realistically. It has been found from experience that if the pupils have some time to satisfy their natural curiosity they will be more willing to devote their energy to accomplishing the tasks necessary to fulfill the purpose of their visit.

It should be fairly obvious to the pupils that there are at least five natural divisions under which the study of the stream or pond could be conducted. These are: making maps, the animal life, the plant life, the soil and the water itself. The following is a list of possible activities which could be carried out in each division.

1. Mapping:
   - making cross sections upon which the other data collected can be plotted or located
   - making a plan map of the area to locate cross sections and other features which might influence the stream community
   - surveying and measuring the longitudinal slope of the stream

2. Animal Life:
   - locating and counting the number of species of small animal life along the banks, in the mud and in the water
   - counting the number of individuals of one particular species
   - recording of the tracks and signs of the larger animal life
   - recording of bird or other animal sounds
   - netting or trapping larger animal or forms of aquatic life

3. Soil:
   - digging small test holes and measuring layers (horizons)
   - testing for moisture in the soil (the porosity)
   - collecting samples of the stream or pond bottom
   - testing for acidity (the PH factor)
   - testing for temperature variations

4. Plant Life:
   - locating and counting the number of species of plant life along the banks or in the water
   - counting the number of individuals of a particular plant species
   - measuring the heights of plants
   - measuring the spread and depth of the plant root systems from the water table

5. The Water:
   - measuring the temperature at various depths
   - calculating the volume of water
   - calculating the speed of the current
   - testing the hardness
   - recording high water marks

Each of these activities will be expanded in greater detail in the following sections of this booklet. The teacher should not expect that any one group or individual would select all of the activities from any section. Instead, the pupil should choose the ones which he feels are most interesting or important. It is to be hoped that he may also wish to add some ideas of his own.

Successive visits to the same stream may be required to collect more data, to refine a technique or to carry out a new activity which has evolved from the original ones. If at all possible, the pupils should have the opportunity to return to their stream during another season and repeat their study so that comparisons can be drawn and the changes that occur over a period of time studied.

If the original stream visited was a narrow, fast flowing one a wider, slower moving variety could be studied next and some comparisons made. Two different ponds could be examined.

If a source of pollution such as a dump or sewer outlet can be located interesting comparisons can be drawn by studying the stream above and below the point of addition of the pollutant. Some streams might be studied before they enter and after they leave an area heavily populated by humans.

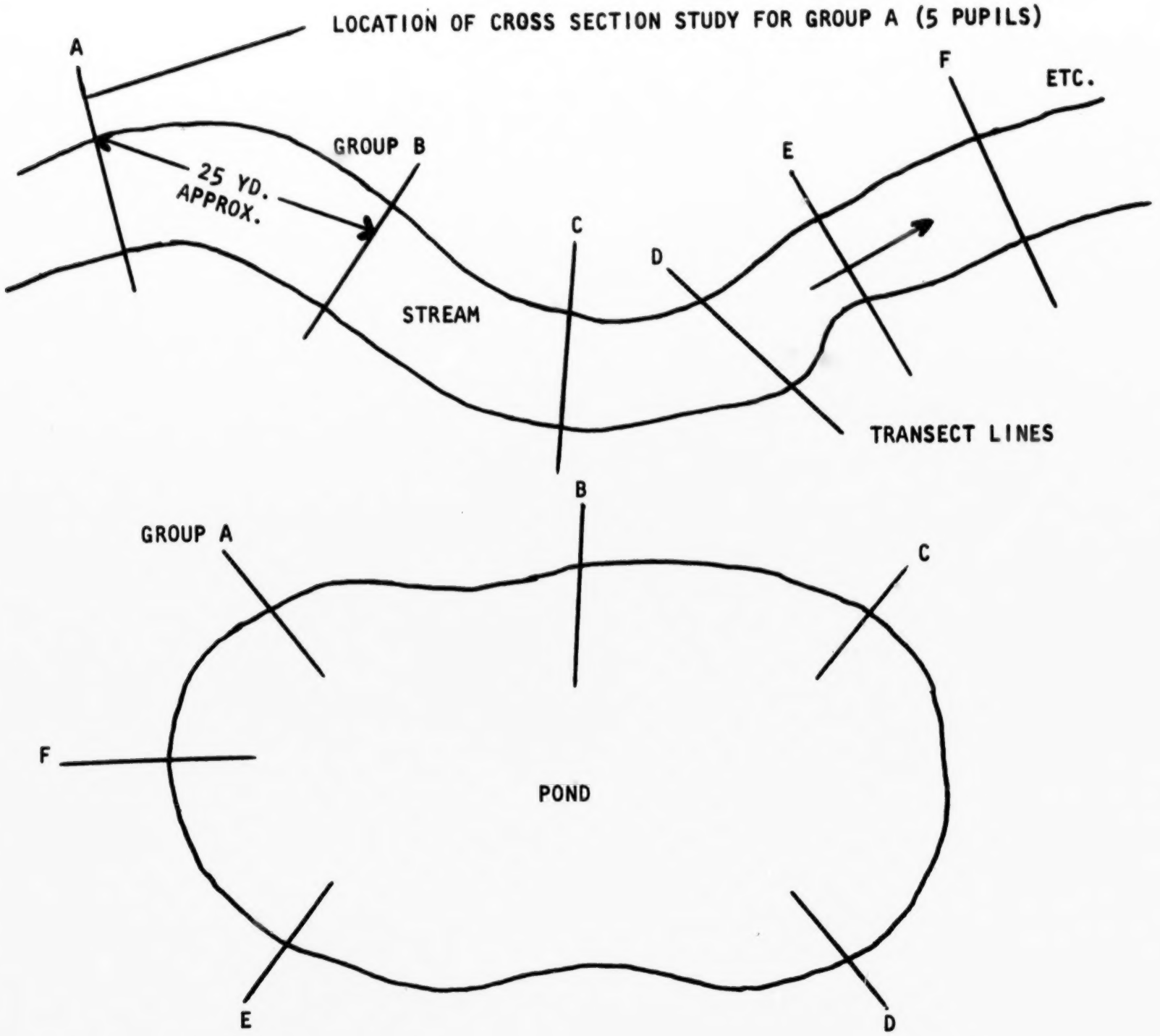
When all the data has been collected and recorded, definite attempts should be made by the class to tie together all the factors of current soil temperature, etc. These factors could be analyzed and used to help account for the existence of the various types of plant and animal life.

SUGGESTED CLASSROOM ORGANIZATION

Because there are five general areas the ideal group size is five pupils. Each pupil could choose one area and perform some of the activities connected with it. As some activities will require two pupils to work together small subgroups which help each other might be formed. Some pupils might help the others in their group if their own task is completed in advance of the rest of the group.

Each group could make one cross section at some point along the stream which they have selected because of its representative or unusual nature. When the investigation is completed the information discovered at each cross section could be charted or summarized and conclusions drawn through group and later class analysis and discussion.

SUGGESTED POSITIONING OF SMALL GROUPS DURING STREAM AND POND STUDY



II SOME SUGGESTED PUPIL ACTIVITIES

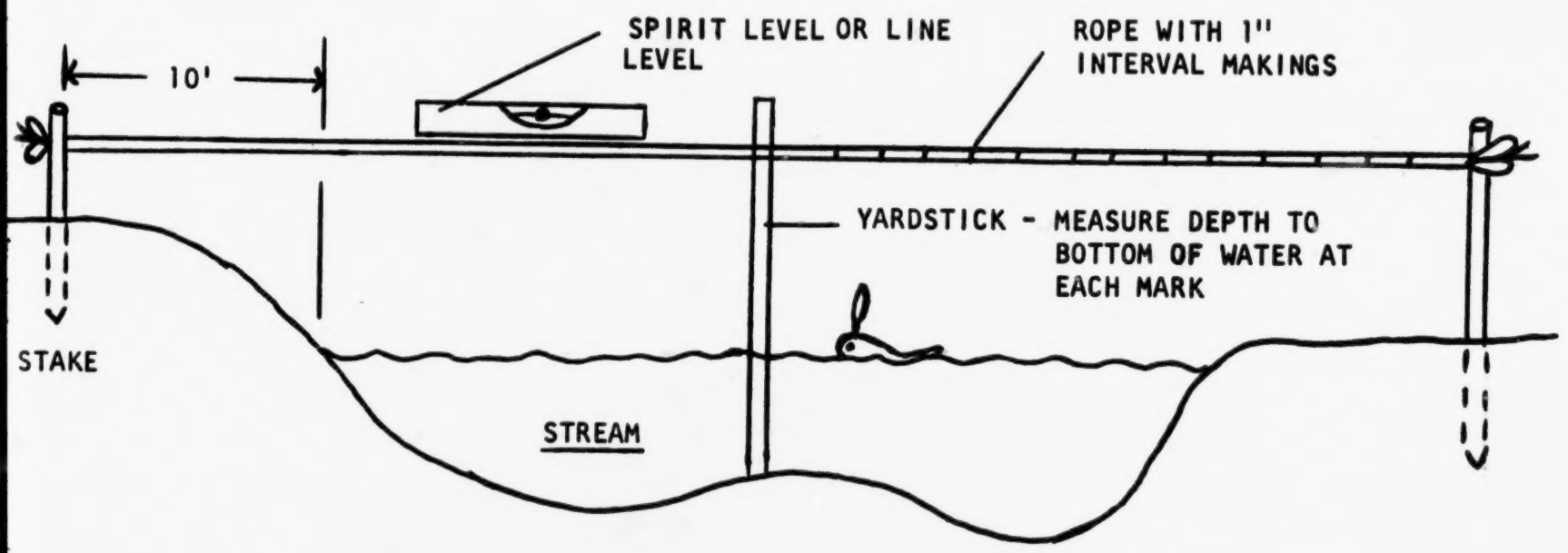
A. MAPPING

This is an extremely important activity because the positioning and marking out of the cross section determines where the samples or measurements of plant life, soil, animal life and temperatures are to be taken. The other activities cannot be carried out until the transect line locating the cross section has been established.

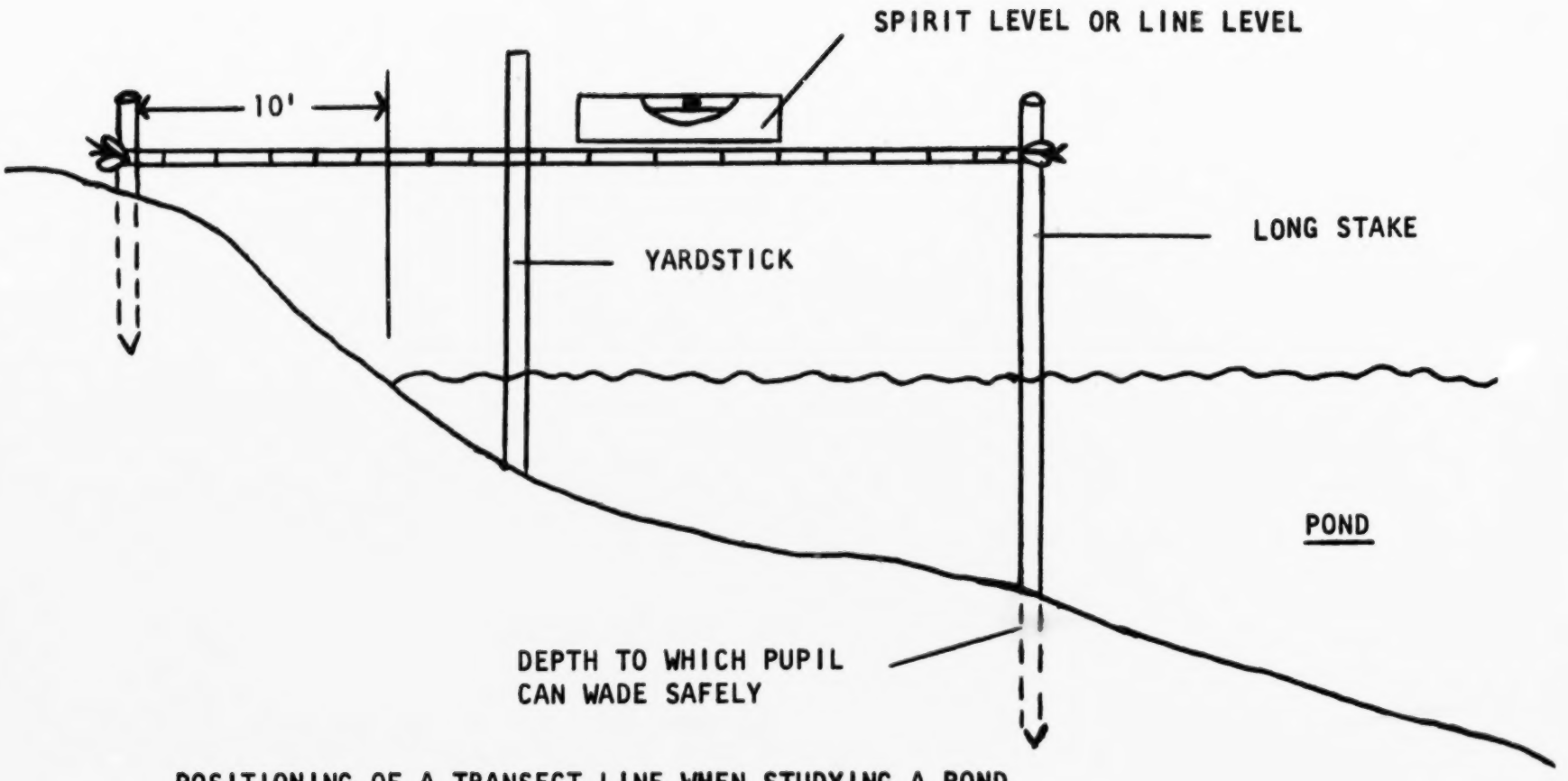
1. Profile Or Cross Sections:

You need a long line, two stakes (old hockey sticks or broom handles), some paint or ribbon, a yardstick or tape measure and a carpenter's small spirit level or line level.

Select the spot at which the cross section is to be made and be sure that the string or rope will extend for at least ten feet beyond the edge of the stream on both banks. Use the paint or ribbon to mark the rope at one foot intervals. Drive one stake into each bank ten feet from the water's edge. Attach the rope to the stakes so that it is taut. Use the carpenter's spirit level to adjust the rope so that it is level. The completed line should be at a right angle to the direction of the main current. By measuring downward from the rope at each marked interval with the ruler or tape measure to the earth or water beneath, a series of measurements can be produced which can be plotted on graph paper. From this a scale drawing of the profile of the stream bed can be made.


10'
SPIRIT LEVEL OR LINE LEVEL
ROPE WITH 1" INTERVAL MAKINGS
YARDSTICK - MEASURE DEPTH TO BOTTOM OF WATER AT EACH MARK
STAKE
STREAM

POSITIONING THE TRANSECT LINE ACROSS A STREAM



POSITIONING OF A TRANSECT LINE WHEN STUDYING A POND

2. Plan Or Bird's-Eye View Map:

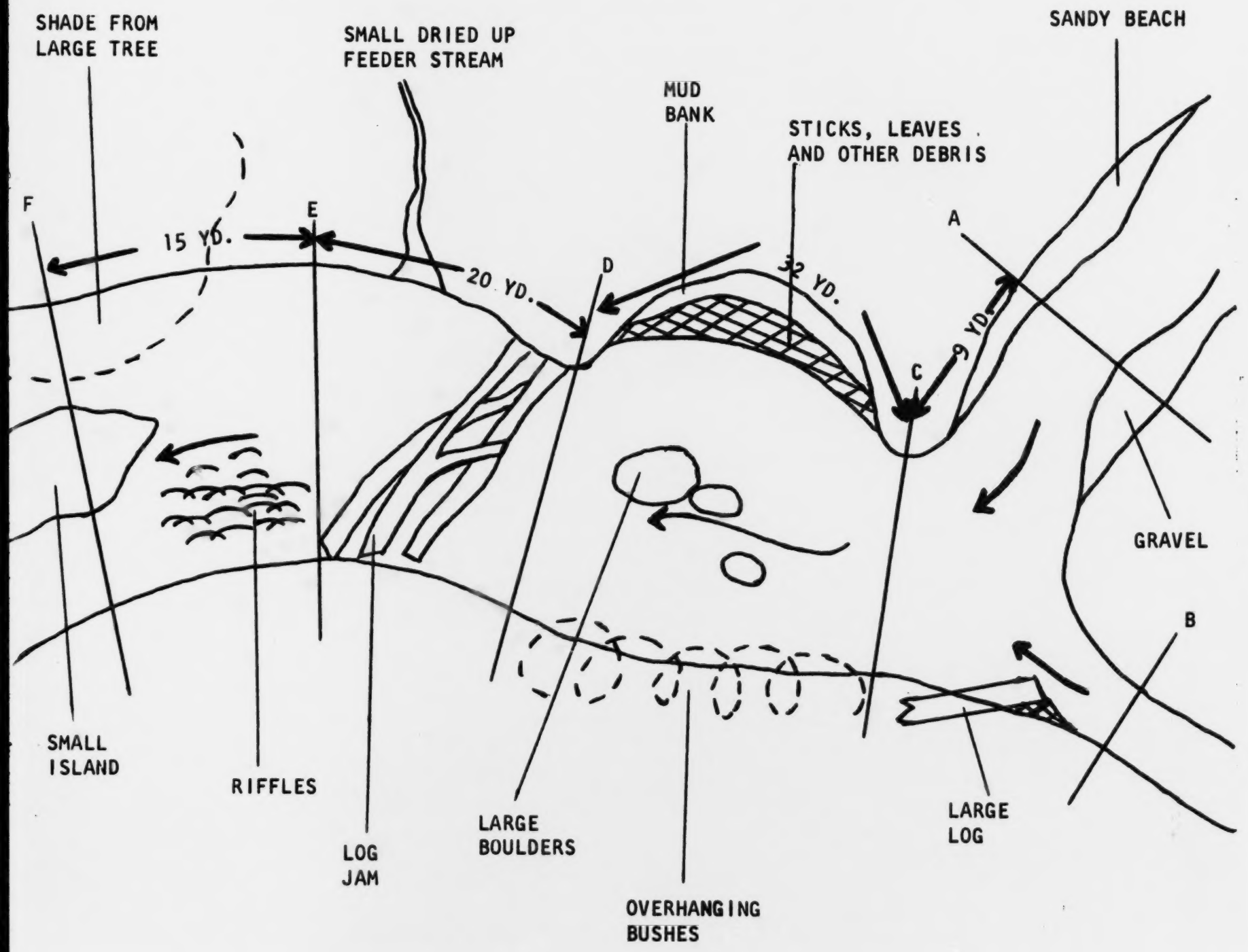
This type of map gives the location of the profile or cross section made by each group. It also indicates where factors are located which would influence the stream flow or affect the life in or near the stream and which would not be found in the cross sections.

Some features which might be recorded on a plan map are as follows:

- small islands
- areas shaded by trees or bushes
- sand bars, gravel beaches, muddy areas
- log jams or rock dams
- riffles (miniature rapids)
- large boulders, large logs
- quiet pools where debris collects
- small tributaries or feeder streams
- direction of stream flow
- eddies or whirlpools

The measurements used in making this map need not be as accurate as for the profiles. The distance between profiles can easily be determined by careful pacing. The width of the stream at various points can be made by using the cross section ropes already established. A few other measurements with a long tape measure may be needed to locate some objects more exactly.

It is not necessary that every group make a plan map of the area but one good one is essential. Two pupils who are not members of any particular group might be assigned this task.



SCALE 1" = 8 YD.

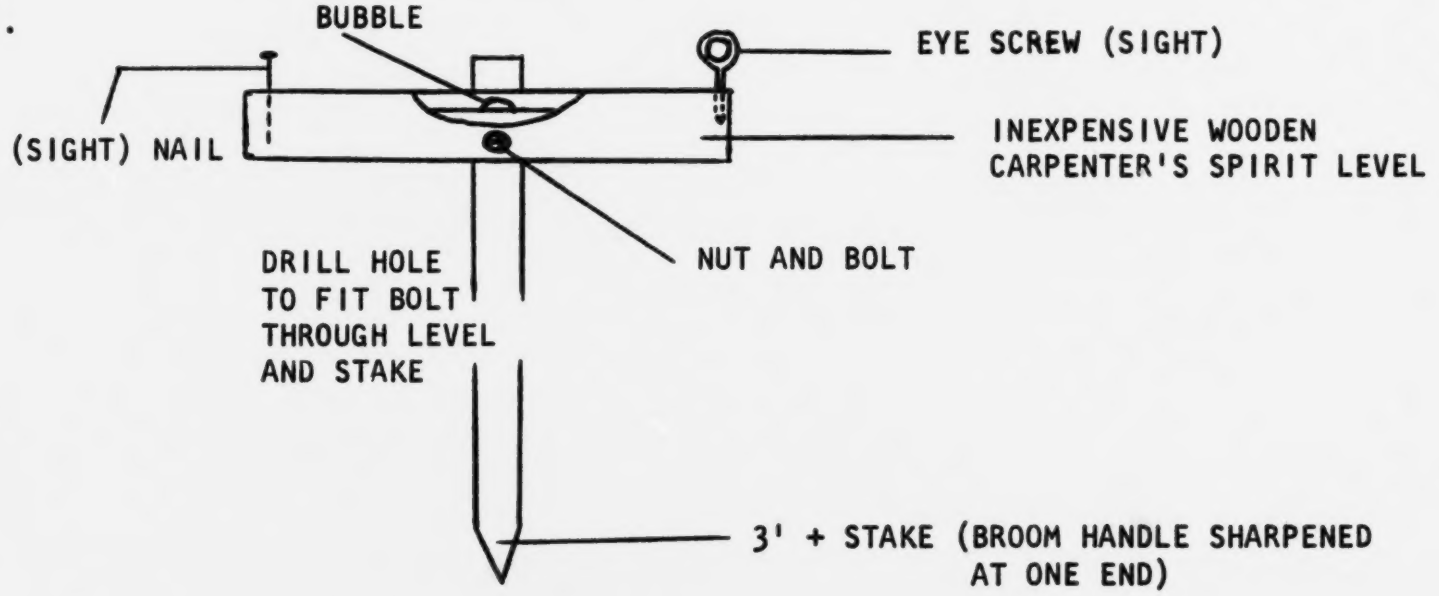
EXAMPLE OF A PLAN MAP OF A STREAM SECTION

3. Surveying The Longitudinal Slope Of The Stream:

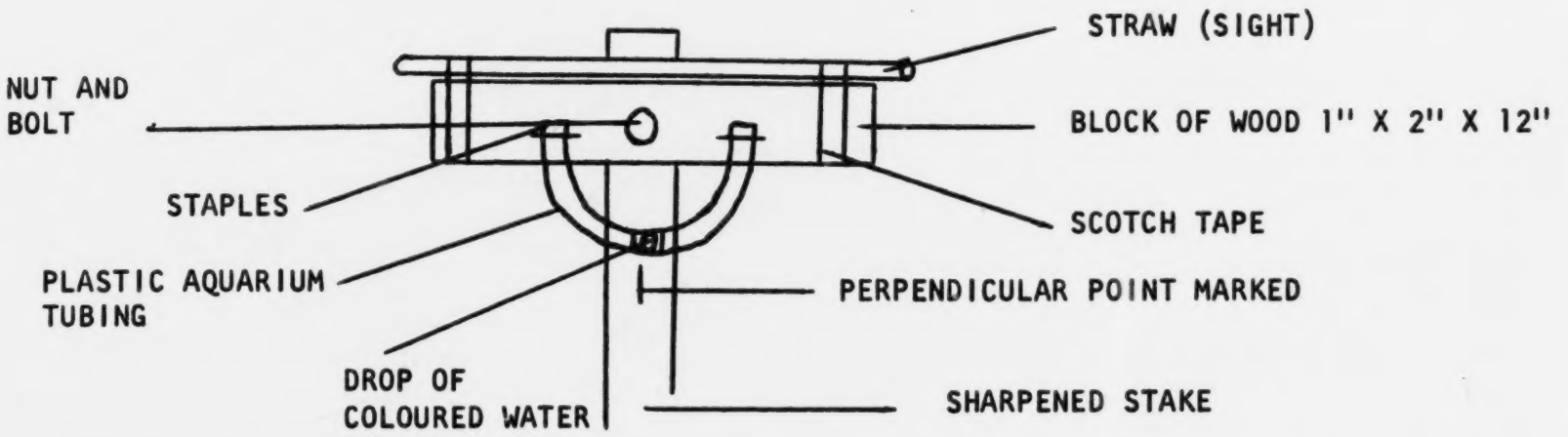
The activity might be the responsibility of the special group making the plan map and need not be necessarily be carried out by each of the 5 man teams.

Simple surveyor's theodolites and rods can be constructed as follows:

1.


BUBBLE
EYE SCREW (SIGHT)
(SIGHT) NAIL
INEXPENSIVE WOODEN CARPENTER'S SPIRIT LEVEL
NUT AND BOLT
DRILL HOLE TO FIT BOLT THROUGH LEVEL AND STAKE
3' + STAKE (BROOM HANDLE SHARPENED AT ONE END)

2.



A rod can be constructed by marking a ten foot length of two by two board into six inch intervals.

Set up the theodolite in a location where all of the transect lines can be seen if possible. Try to hold the stake as exactly upright (plumb) as possible. A string with a washer on the end could be used to help align

the stake. Adjust the angle of the theodolite until the bubble indicates that it is level. Repeat this adjustment each time a reading is to be taken. Have a second pupil hold the rod as upright or plumb as possible in the centre of the stream at each transect line. Sight through the straw or other sights of the theodolite at the rod. Have the pupil slide a pencil up or down the rod until it appears in the centre of the sights. Record this distance from the pencil to the base of the rod.

Several readings should be taken at each transect line and averaged. The theodolite should not be moved other than to turn it until all the required readings are completed for each transect line.

By carefully plotting these measurements on graph paper the slope of the stream from point to point can be seen.

B. ANIMAL LIFE

If the pupils anticipate viewing larger animals such as racoons, muskrats, ducks, cranes, fish and turtles, etc. they are going to be disappointed. They will be indeed fortunate to be even allowed a fleeting glimpse or to find the occasional sign which might indicate the presence of the larger animals which sometimes frequent the stream. However, if they concentrate upon the insects and other forms of invertibrate life and are willing to search diligently to find them the possibilities for discovery and productive investigation are excellent.

4. Animal Life Along The Banks:

Small animal life along the banks in the area which extends from the shore to the 10 ft. marker stake will be found by examining: (a) the plants (b) the surface of the ground or (c) in the soil to a depth of about six inches. The pupils might examine these three areas by getting down on their knees and peering intently and carefully at a very small area. (This technique is called grovelling!) The areas selected should be directly under the one foot interval markings of the lines extended between the two stakes.

It is not necessary that the pupils identify what they see according to its name but some attempt should be made to classify it. This could be accomplished by describing its main characteristics, measuring its size, sketching it, etc. and then designating a symbol or letter to represent it. This information could be used later in designing a key. A few samples could be collected in pill vials or baby food jars for positive identification upon returning to the classroom if there is a strong desire to do this on the part of the pupils.

It is very important that the pupils be able to know: (a) the number of different species which live in the area (b) precisely where they were found and (c) how many of each were found there.

Samples of the soil could be dug up to a depth of six inches (very little life occurs below this depth) placed in plastic bags, taken back to the classroom, spread out on a paper towel or newspaper and examined bit by bit with tweezers and a magnifying glass. The samples should be taken directly under the interval markers and the number of each species found recorded. Be sure to have the plastic bags and other containers labelled as to the location in which the specimens were taken.

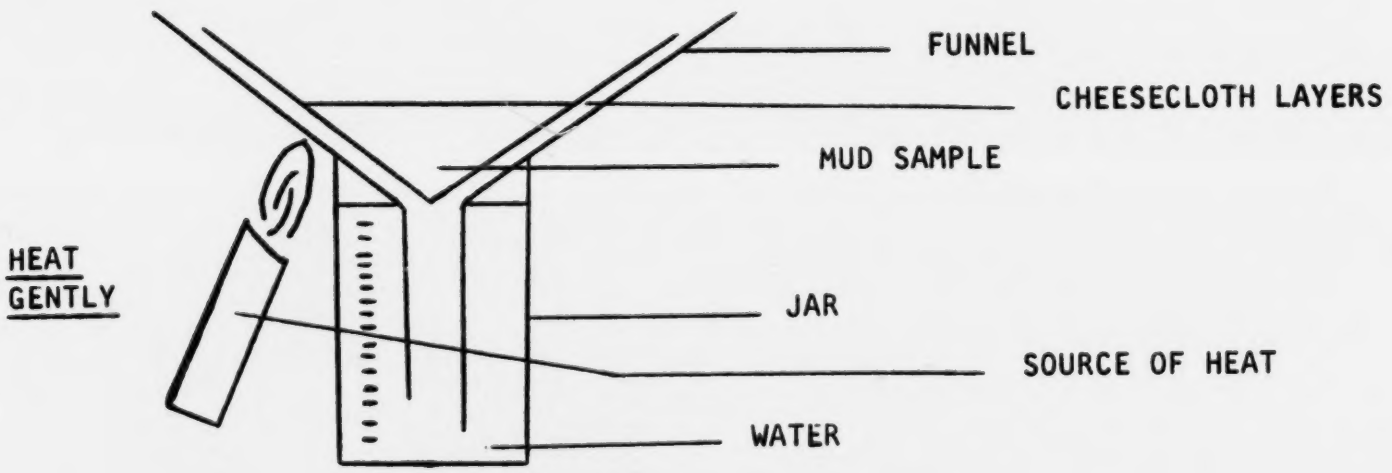
The pupils might like to prepare sheets in advance upon which they can record their data. Such a sheet might look like this.

	LOCATION ON PLANT ON SURFACE IN SOIL	INTERVAL MARKER ie. 3'6' ETC.	SPECIES NAME SYMBOL OR LETTER	DESCRIPTION AND SIZE	NUMBER FOUND
1	Surface	5 ft.	Ant	Red 1/2"	3
2					
3					
4					
5					
6					
7					
8					
9					
10					

5. Animal Life In The Mud Of The Shore Or Bottom Of The Pond Or Stream:

Use kitchen sieves or strainers to examine the mud directly under each interval marker where applicable. Record the number and types of snails and larger worms which remain in the strainer after the mud has been washed out.

Collect samples of the mud directly under each interval marker, label the location and transport them back to the classroom in pill vials or baby food jars. Do the following in order to reveal the small life which would not normally be seen.



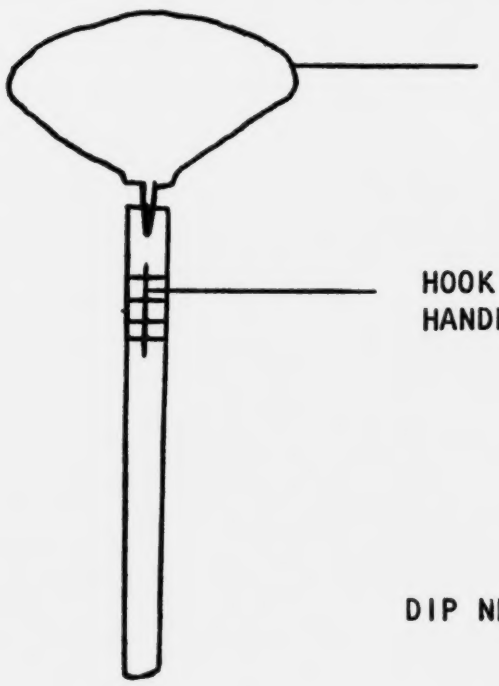
SMALL ANIMALS WILL BURROW DOWN INTO JAR OR BOTTLE.

6. Animals In The Water:

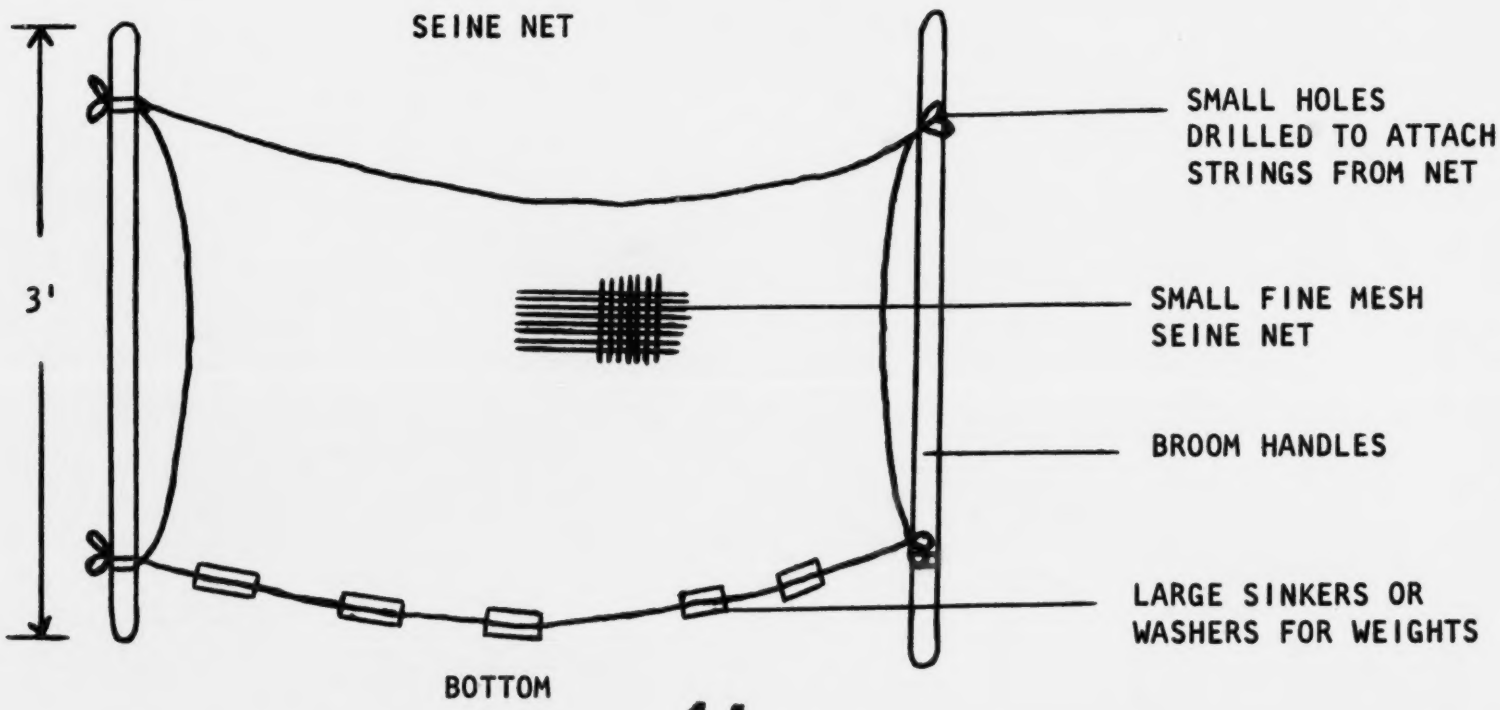
If the stream or pond is wide and deep enough the pupils may wish to try their skill with a seine net. An old smelt net or other seine net with a fine mesh can be used. Excellent nets can be constructed from broom handles or hockey sticks and the replacements for small fishing nets (obtainable from sporting goods stores for approximately $1.50).

Small dip nets can be made from cheesecloth tied to a bent coat hanger wire.

If the pond or stream is easily accessible minnow traps can be left overnight and checked the next morning.



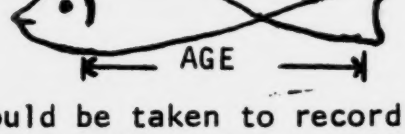
DIP NET



When using this type of net two students will be needed. Be sure to hold the net tilted at a 45° angle to the direction of the stream flow not vertically. Make short sweeps against the current. Keep the base of the net as close to the stream or pond bottom as is possible. Lift the net up horizontally to examine its contents. Sweep with the net toward the banks in order to trap the fish.

The minnows or crayfish obtained by this type of fishing could be placed in a pail of water measured and recorded and then released.

A technique used in examining fish is to remove one scale from their body by rubbing with the finger from back to front along the scales. Place it in an envelope on which other pertinent information is written and then examine it later with a microscope to count the annual growth lines. In this way the age of the fish is calculated. Generally speaking relative age of a fish can also be calculated by measuring the distance from the gill slit to the tail notch.



Once again special care should be taken to record where the fish or tadpoles were caught, how many and their size. Some pupils may wish to prepare an identification chart of the possible fish which might be caught before visiting the stream but it should be remembered that identification of species is relatively unimportant.

If fishing is out of the question the pupils can still collect specimens of the water for microscopic analysis upon returning to the classroom. Be sure to collect samples from the surface, middle and bottom directly under each interval marker and to write the precise location on each container. A count of how many kinds of life and how many of each kind should be recorded.

7. Animal Tracks and Signs:

(i) Plaster Casting (How to Make a Good Impression)

Introduction

Plaster casting is a somewhat unusual and fascinating way for children to record some of the evidence of plant, bird or animal life that they might encounter on a field trip. This technique can be used in the child's backyard to record and identify the animal life active at night. In the classroom plaster casts make excellent items to display in the science corner, or they can be used by the teacher as concrete material (no pun intended).

Materials

1. Plaster: (a) Plaster of Paris - $2.50 for 50 lbs. - course, white, medium rate of drying.

(b) Patching plaster - expensive for small amounts - fine grain - white, slow drying.
(c) Dental plaster - $3.50 for 50 lbs. - fast drying, fine grain - white. (The best)
(d) Texture paint - variety of grains and colours. Expensive for small amounts - medium drying rate. Can be softened by water and reused.

Pupils could carry small amounts of plaster in plastic bags to avoid spillage.

2. Mixing bowls: Styrophome or paper cups, cardboard cottage cheese or sour cream containers are preferable to tin cans or glass jars because of the weight and disposal problems of the latter. These containers are flexible so that hardened plaster can be removed by compressing the container's sides so that the containers can be used over again.

3. Spatulas: These can be improvised from popsicle sticks or tongue depressors.

4. Collars: These can be made from sealed envelopes which have been cut crosswise into one inch strips. Strips of bristol board, thick cardboard or folded note paper can also be used.

5. Paper clips: Use these to attach the ends of the collars or to act as hangers when inserted into the back of the casts.

6. Salt: Use this to harden the plaster more quickly if necessary.

7. Water: Add the salt to the water to keep it from freezing in the wintertime. Transport the water in plastic vinegar or bleach bottles if a good source is not readily available.

Methods

1. Most tracks will be found in the moist sand along the banks of streams and ponds. The barnyard is also an excellent place to look for tracks. A cookie tray or similar container filled with moist fine sand can be used in the backyard or right in the classroom. If natural tracks are scarce, very authentic looking substitutes can be manufactured by pressing on the sand with various parts of the hand.

2. When a suitably clear footprint has been located, remove any debris carefully. It may be necessary to use a stick or your finger to repair a damaged portion of the print.

3. Press a suitably sized collar, to encircle the footprint, into the soil so that no liquid plaster will ooze out underneath it.

4. Mix the plaster in small amounts by adding water to the plaster, a few ounces at a time. Stir until the mixture resembles thin whipped cream and all the lumps are gone. Salt from the salt shaker could be added if the footprint is on wet ground in order to speed up the hardening of the plaster. Caution: Don't add the salt until the plaster is ready to be poured.

5. Pour the plaster into the collar filling the track first. Tap the collar gently with a stick to get out the air bubbles and to make sure that the plaster flows into the fine areas of detail such as small paw marks. This will also help to produce a flat and level back when the last batch of mixture is poured.

6. The collar should be filled to a depth of from 3/8 to 1/2 inch or more to insure sufficient strength. A paper clip or a hanger could be inserted in the semisolidified plaster.

7. Allow sufficient time for the back to harden so it can be tested without marking by a fingernail. This will be at least 15 minutes.

8. Remove the track from the earth. Peel off the collar and allow a period of time for the face to harden before washing off the dirt which still adheres to the face.

9. Use a table knife to trip the edges by scraping off the excess plaster.

10. Boil the cast in a solution of Borax (1 tbsp. to 1 pt. of water) for 20 minutes to harden the plaster cast so that it is almost like rock.

Casting Negatives

The cast you have already obtained will resemble the part of the foot of the animal or bird which made the print. This is called the positive. To make the negative, or what the print on the ground would look like, smear the positive liberally with vaseline (petroleum jelly). Add another tight fitting collar and then mix and pour the plaster as before. Avoid using casts of tracks which would have undercut parts in behind which the new plaster would harden and thereby prevent the negative from being separated from the positive. When the negative is hardened, peel off the collar, separate it from the positive, and wash off the vaseline.

Making Castings in Wintertime

If it is very cold, carefully spray the track in the snow with an atomizer type of bottle and a solution of salt water. If it is mild enough for snow to be melted by water, spray the track with a plastic type of hair spray before you pour your cast.

Uses and Follow-up Exercises

1. The identification of animal or bird species from resource books in the classroom. It is often useful to sketch the tracks in order to show their arrangement or pattern and to record where it was found so that more complete information about the animal is available. Eg. If the animal was running, or any peculiarities of how it walks or travels.

2. Observation of the feet of animals and birds is useful in determining their function.

3. Casts can be painted with contrasting colours to separate the foot part from the background in an art lesson.

4. The casting technique can be used to obtain class sets of fossils and leaf types.

Some Reference and Other Materials

1. A collection of 8 to 10 moulds of animals of Canada can be obtained from the National Museum of Ottawa for approximately 65¢.

2. The Field Guide to Animal Tracks of the Peterson Series by Murie is an excellent resource book.

3. Animal Tracks & Hunter Signs by Ernest Thompson Seton published by Doubleday.

4. Animal Tracks by G. F. Mason -- Animals at Home Series, Phoenix House.

This section was included in the hope that you will have fun following in the mold of nature.

(ii) Animal Noises

Although the pupils may not actually see some birds or amphibians they may make their presence known by the sounds that they make. An attempt could be made to list these sounds by mimicking them, ie. the redwing blackbird's song is o-ker-ee, o,ker,ee.

The sounds heard could be related to the air temperature and the time of day in order to uncover some interesting relationships especially around a pond.

C. THE SOIL

Here is a chance for the pupils to perform some really down to earth activities.

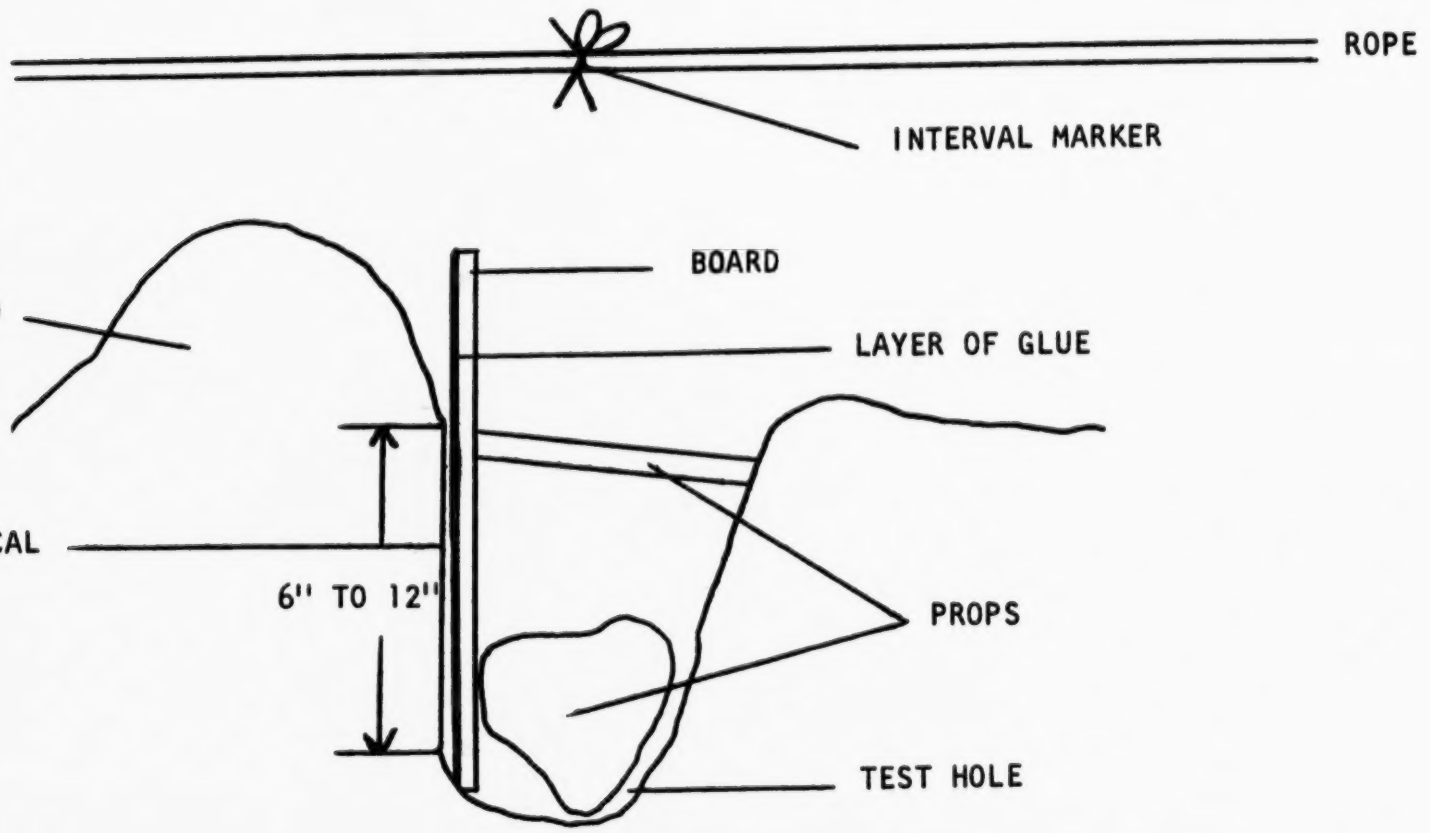
8. Soil Profiles:

Use a garden trowel to make test holes below the interval markers at distances of about one yard apart. These holes should be at least six inches and no more than one foot deep. Make sure that one side of the hole is flat and vertical. Use a ruler to measure the layers of various colours which can be observed in each hole. Each line is called a horizon. The horizons are usually labelled in a downward direction A, B, C, etc.

If a permanent record of the soil cross section (soil profile) is desired, the pupils could do the following:

(a) Collect samples of the soil from each layer in plastic bags for transportation to the classroom. Upon returning to school spread glue on a board or piece of cardboard of suitable size and then glue on the soils according to the measurements which they had recorded.

(b) If the pupils can return to the site the following day then this procedure could be followed. Place glue on a flat stick of suitable size. Press the glue side of the stick against the vertical side of the hole. Use other sticks or stones to hold it firmly in place. When the board is removed the next day the soil will adhere to it and a pattern similar to that found in the soil section will be obtained.



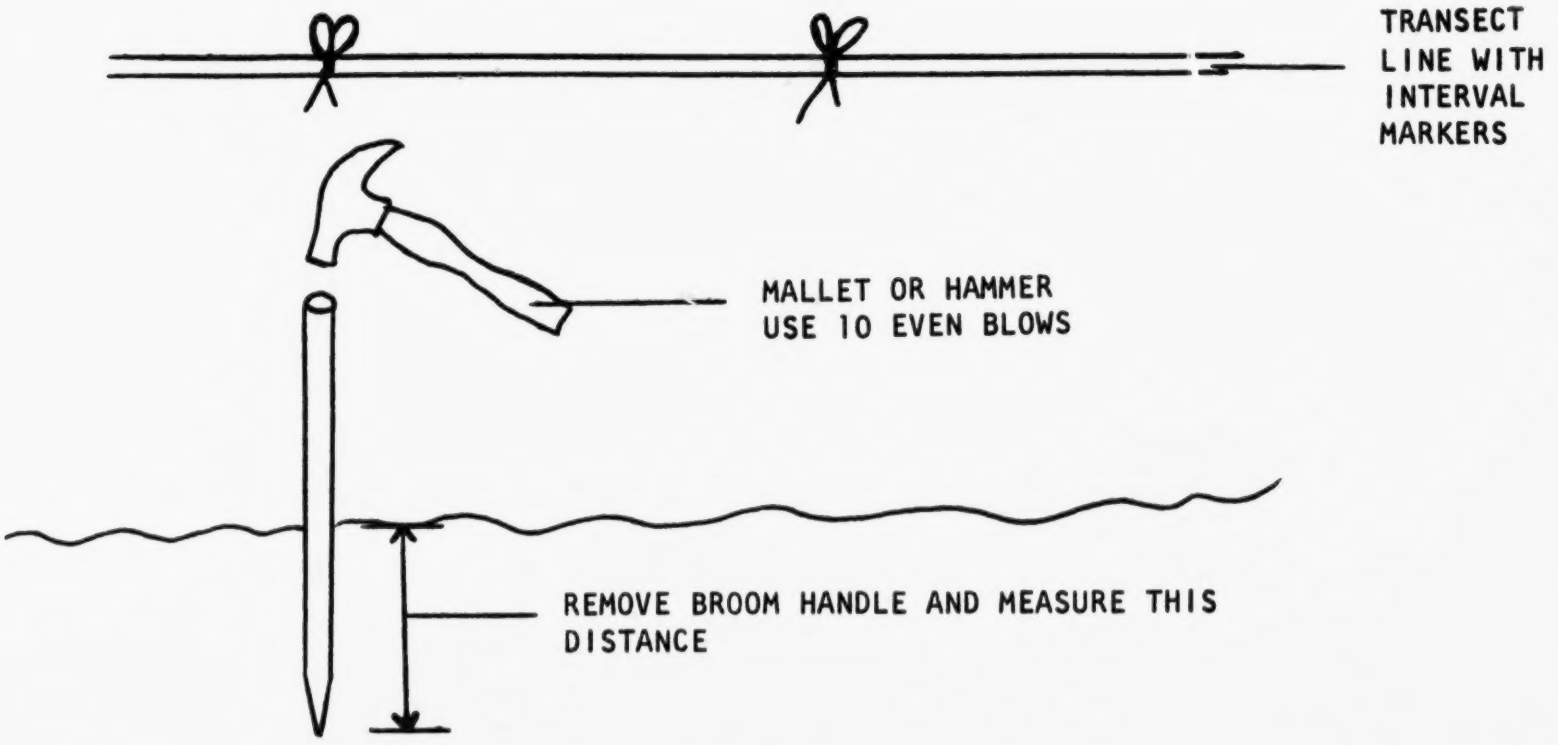
SOIL PROFILE PIT

NOTE: BE SURE TO FILL ALL HOLES DUG BEFORE LEAVING STREAM OR POND SITE.

9. Hardness Of The Soil:

A length of broom handle approximately one foot long which has been sharpened to a point at one end, a hammer and a ruler will be needed.

By using as nearly the same force as possible for each blow with the hammer and the same number of blows, ie. 10, drive the broom handle into the soil. Do this under each interval marker wherever possible. Measure the distance the broom handle was driven into the ground.



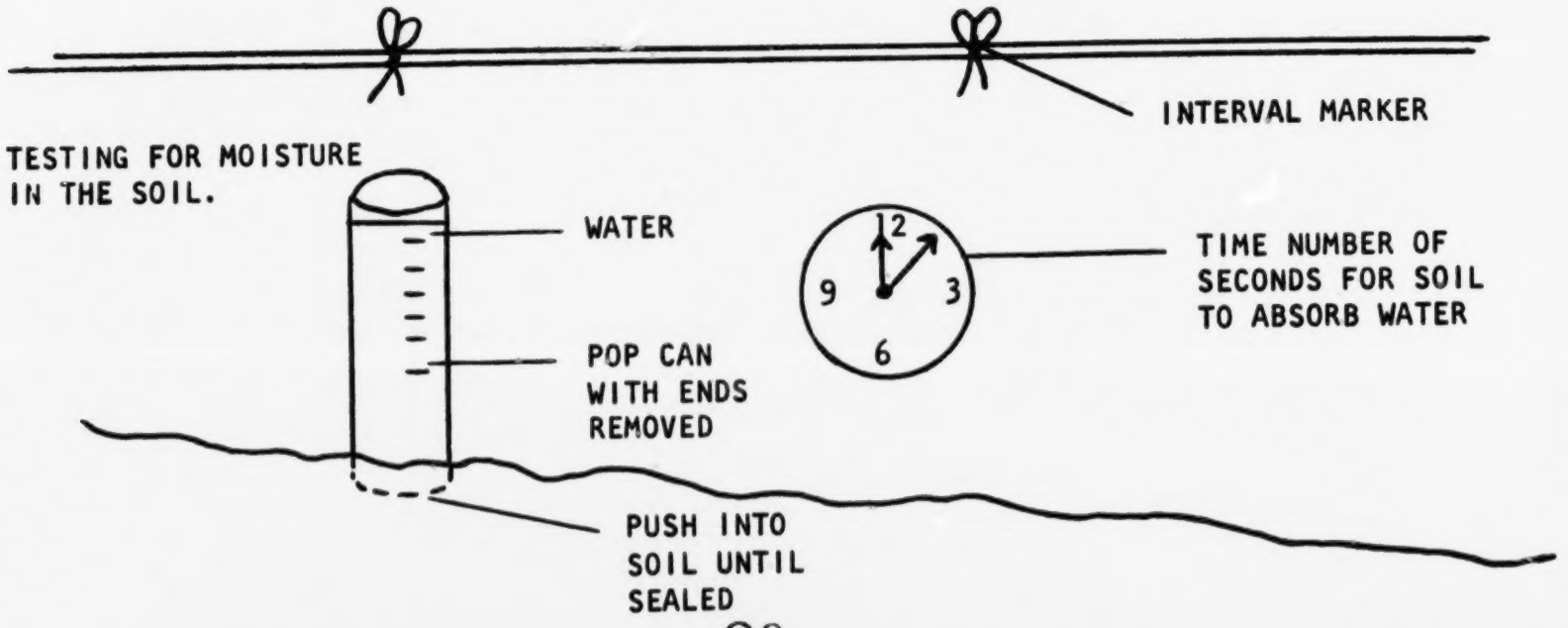
TESTING THE SOIL FOR HARDNESS

10. Moisture In The Soil:

Some indication of the amount of moisture in the soil can be measured by the following procedure:

Cut both ends from a juice or pop-type can. Push the can into the soil just far enough to make a seal. Pour water into the can until it is filled to the brim. Time the number of seconds required for the water in the can to seep into the soil.

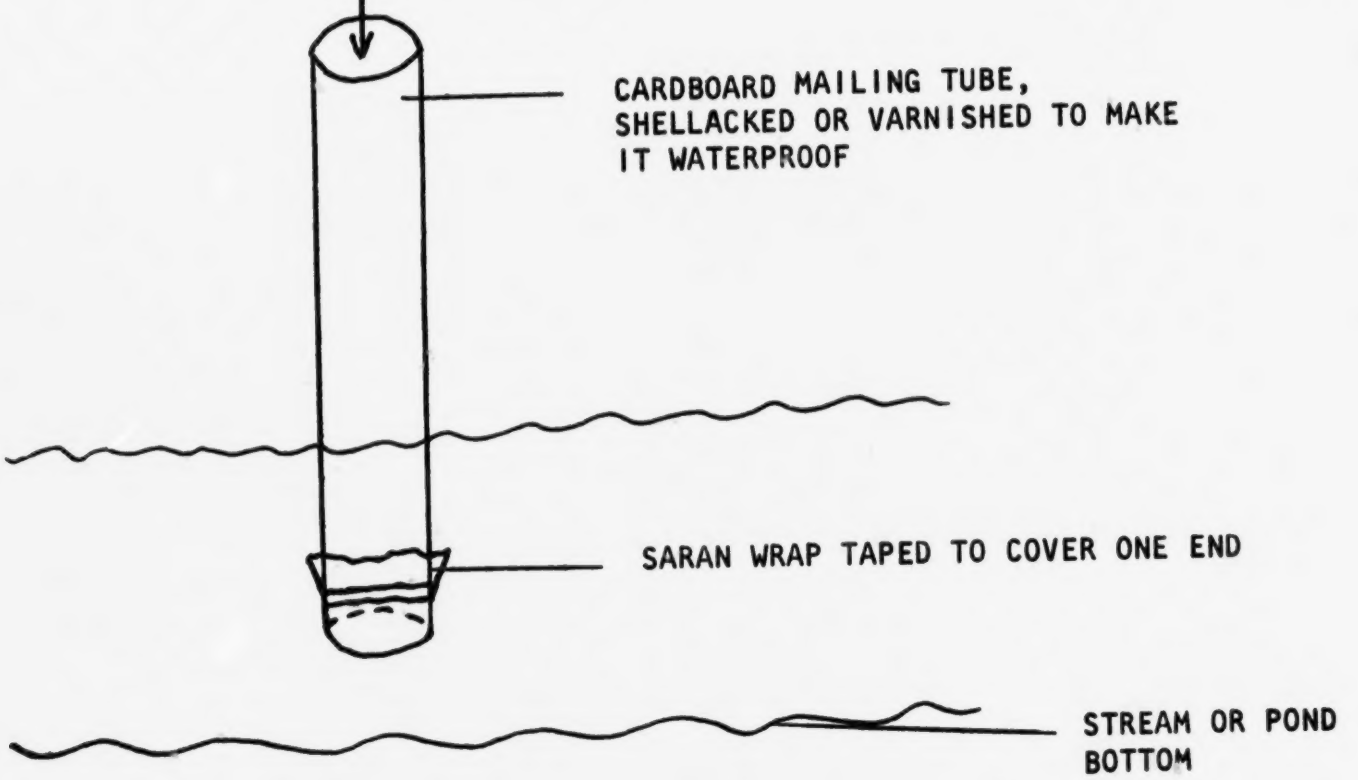
Perform this test at each interval marker wherever possible.



11. Collecting Samples Of The Stream Bed:

Use a trowel or scoop to obtain samples of the gravel, sand or other sediments which compose the stream or pond bottom. Take samples directly under each interval marker. Samples can be transported back to the classroom in plastic bags or baby food jars. Have the pupils who carry out this activity sort and classify the materials collected and brought back as to size and kind of material found.

If the following piece of apparatus can be constructed the actual bed can be viewed and sketched.


VIEW THROUGH THIS END
CARDBOARD MAILING TUBE, SHELLACKED OR VARNISHED TO MAKE IT WATERPROOF
SARAN WRAP TAPED TO COVER ONE END
STREAM OR POND BOTTOM

VIEWER USED TO EXAMINE STREAM BOTTOM

12. Testing For Acidity:

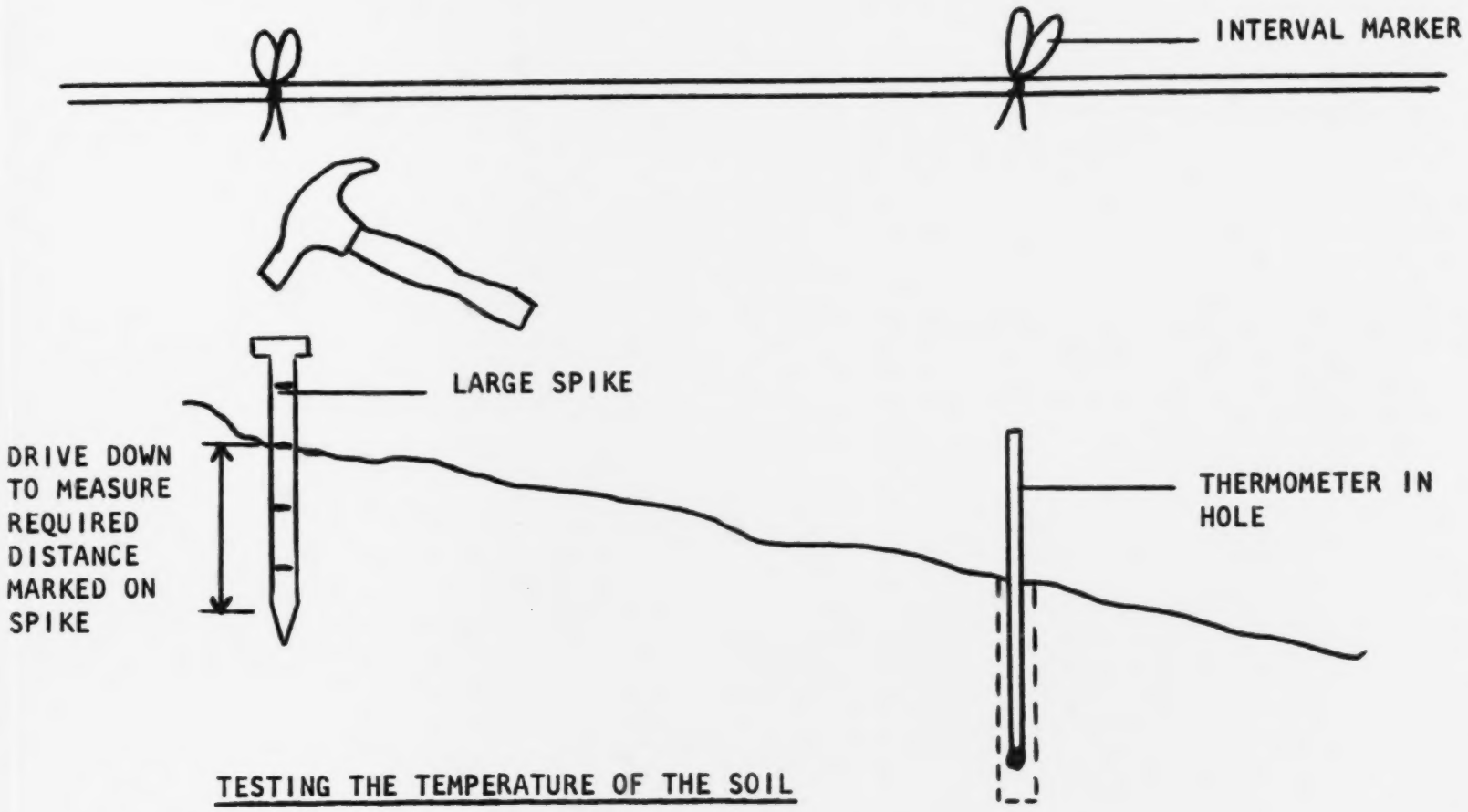
For this activity a soil testing kit will have to be purchased. There are many types but the one recommended is Hydrion Soil PH tester ($2.85-#28226 Cenco or equal). It consists of paper strips (similar to litmus) which when moistened and placed in the soil turn a variety of colours depending upon the degree of acidity of the soil. The paper is then composed with a colour chart furnished as part of the kit and a number from 4 to 9 is obtained.

Be sure to test the soil under each interval marker wherever possible.

13. Testing For Temperature Variations:

You can use a hammer, a large spike, a ruler and a thermometer. Use the hammer and spike to make a hole in the soil into which the thermometer can be lowered.

Make the holes directly under the interval markers. Deepen the holes an inch at a time up to six inches deep and take readings at each level. Be sure to allow at least two minutes for the temperature to adjust and to allow for the change in temperature if the thermometer must be withdrawn in order to be read.



TESTING THE TEMPERATURE OF THE SOIL

The temperature of the air at the ground surface and at intervals of one foot up to three feet could also be taken at each marker.

D. PLANT STUDY

The method used to determine the main types of vegetation and to get some idea of the plant populations found along the stream is called a line transect.

14. A Line Transect:

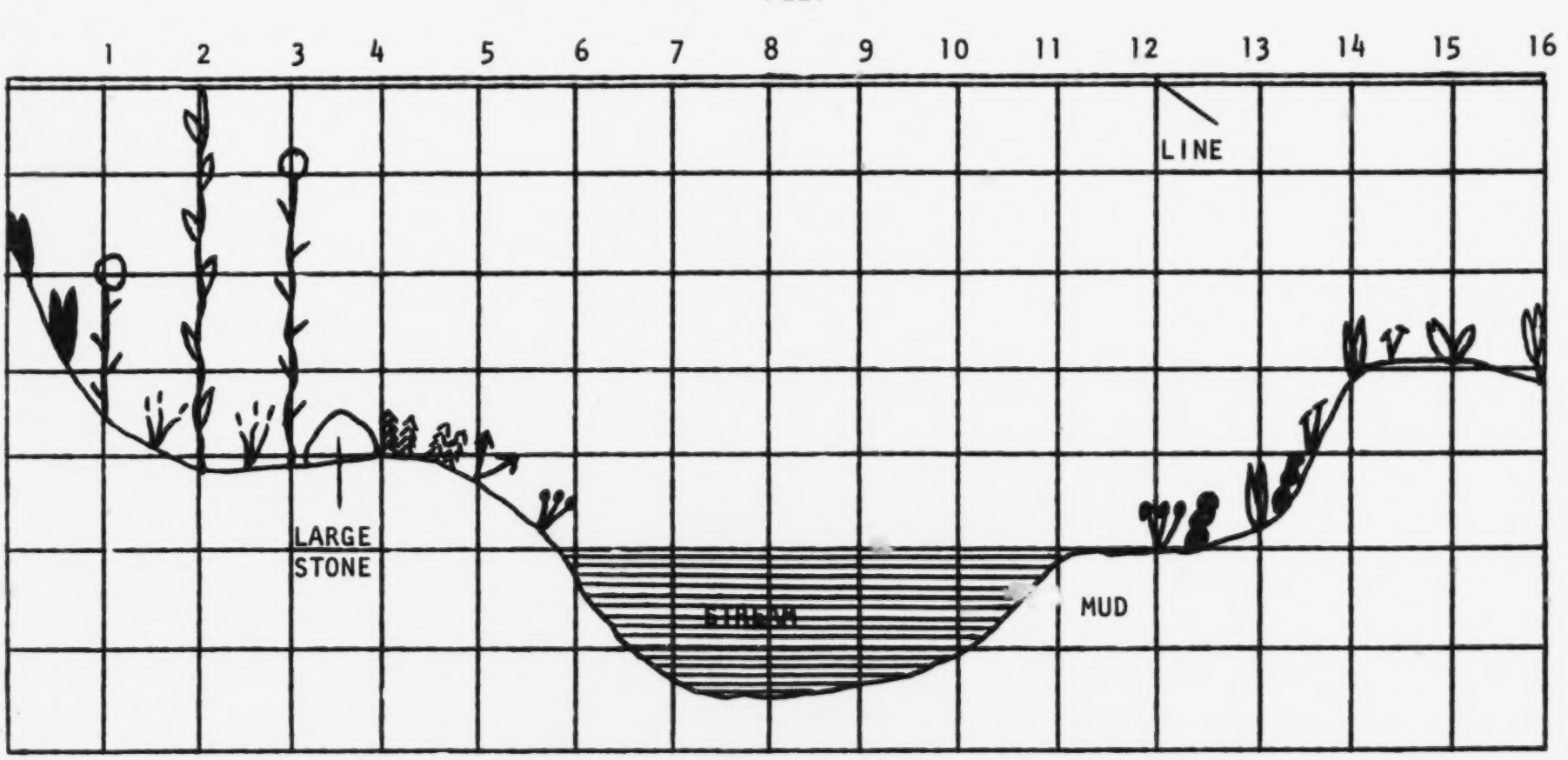
Examine the plants found directly under each interval marker on the line. Those plants located half way between each marker could also be examined.

Use a meter stick or tape measure to find the height of the plant by measuring downward to the top of the plant from the line.

If you do not wish to remove the whole plant,simply remove one typical leaf. Either the plant or the leaf should be put into a plastic bag along with a little water to keep it from drying out while it is being transported to the classroom. Be sure to label the location where each specimen was obtained.

Upon returning to the classroom the plants or leaves could be classified by assigning each different variety a letter, ie. type A, B, C, etc. The numbers of each variety could be counted and the most common (dominant), least common, etc. type of plant life discovered.

The information when sketched or plotted on large graph or chart paper might resemble this.



KEY:
A PLANTAIN
B WILLOW
C MEADOW GRASS
D BUTTERCUP
E MINT
F HORSETAIL
G SWAMP MILKWEED
H ARROW HEAD
I UNKNOWN GRASS
J DEER GRASS

EXAMPLE OF PLANT LIFE AS INDICATED BY A LINE TRANSECT STUDY

15. Plant Roots:

Carefully remove one plant found directly under every other interval marker so as to damage the roots as little as possible. After, examine the roots. The following are some of the types of information which might be recorded:

(a) location of plant
(b) type of root system - top or fibrous
(c) length of average root in the system
(d) side on which most roots found growing
(e) depth to which average root grows

This information could be related to moisture in the soil, distance from pond or stream and other factors upon returning to the classroom.

16. Plant Life In The Water:

In most streams which possess a steady flow of water aquatic plant life will not be found. In a pond, however, where the current is negligable a variety of plants can be obtained for study. Similar methods to those outlined in Activity 14 can be utilized. Water plants may also be found along the banks of the stream or clinging to rocks and stones.

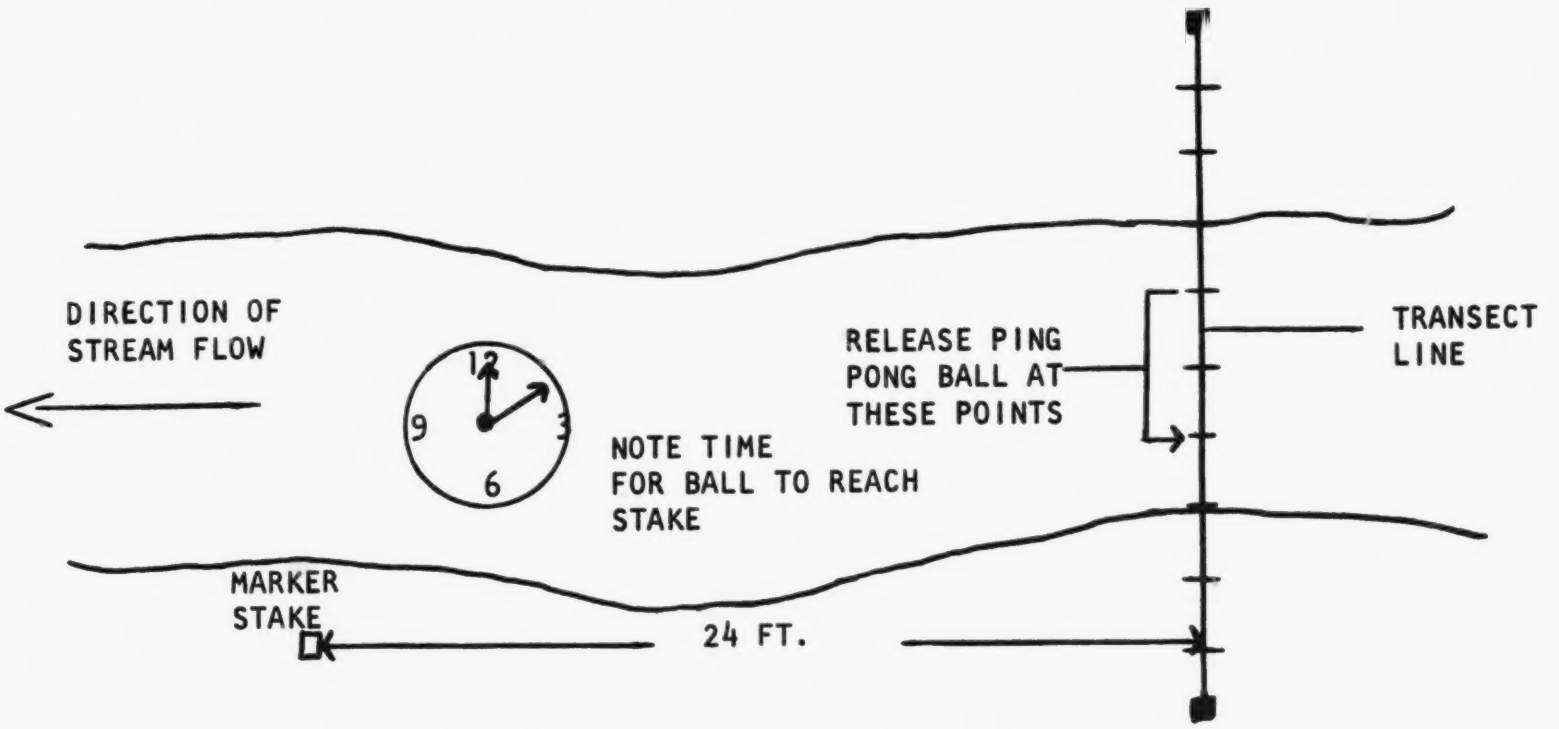
E. THE WATER

17. The Speed Of The Current:

Use a string or stakes to mark off a section of the stream 24 feet in length (this number was chosen to help make the arithmetical calculation somewhat easier). This section should extend downstream from the transect line already established. A ping pong ball or other suitable piece of floating debris is released from the starting line and the time it takes to reach the 24 foot marker is recorded. Several trials should be made and the average time calculated. The ball should be released at different distances from the shore as indicated by the interval markers on the transect line. It will be found that the current nearest the centre of the stream will be faster than the current found closer to the shore line.

In a pond the current may be related to the wind direction and speed so these should also be measured. Perhaps a feather vane or anemometer (see Mini Climates) could be constructed and used.

METHOD OF DETERMINING SPEED OF CURRENT

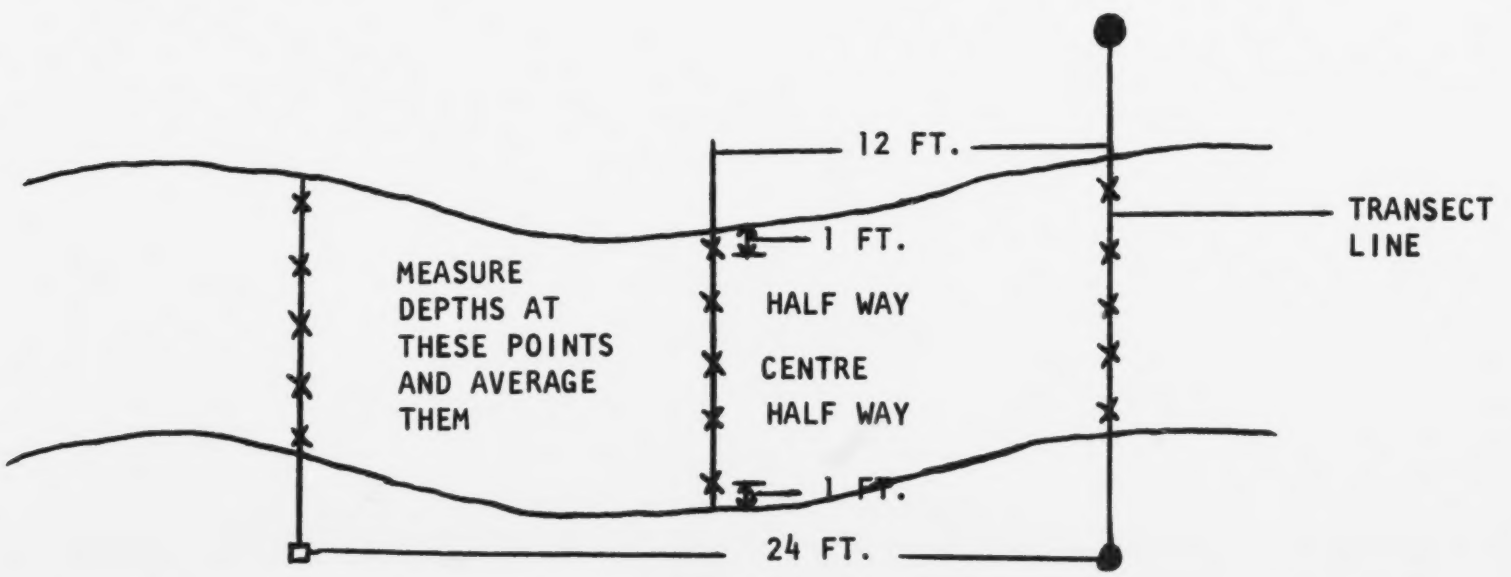


18. The Volume Of Water:

This activity is almost impossible to perform in a pond. Find the average depth of the 24 foot section of the stream used in the previous activity. To do this take readings at the transect line, the 24 foot marker and half way between (12'). Measure the depth one foot from each shore line in the centre and half way between. The area of each cross section can then be calculated and the three results averaged. This number can then be used in the following formula to determine the volume of water passing through the area at that time.

$$\text{Average Area} = \frac{(\text{Average length} \times \text{Average depth}) \times 24 \text{ ft.} \times .8}{\text{Average time (from Activity 17)}}$$

The .8 is necessary to account for the friction between the water and the stream bed.

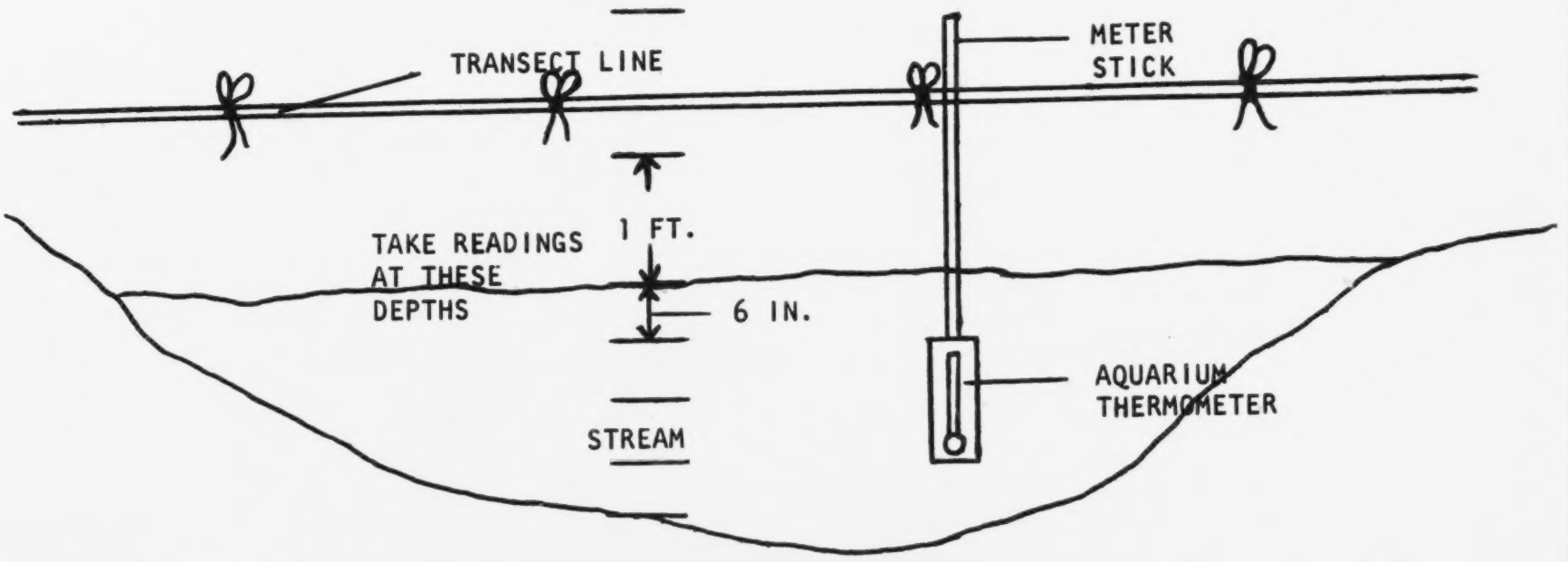


A meter stick and a pole marked at intervals of one foot may be useful in measuring depths and widths at the 12 and 24 foot distances.

Interesting comparisons can be obtained by conducting this study after a rainstorm, in the spring then in the fall, or at increasing but widely separated distances from the source of the stream.

19. Measuring The Temperature Of The Water:

A thermometer similar to the type used in aquaria is most useful but almost any other type could be used. Take readings at the surface of the water and at six inch intervals until the bottom is reached. If the soil group has not already done so temperature readings could be taken in the sediment at the bottom of the stream or pond also. As always the readings are taken directly under the interval markers of the transect line so that they can be plotted along with other information later.



METHOD OF OBTAINING WATER TEMPERATURE

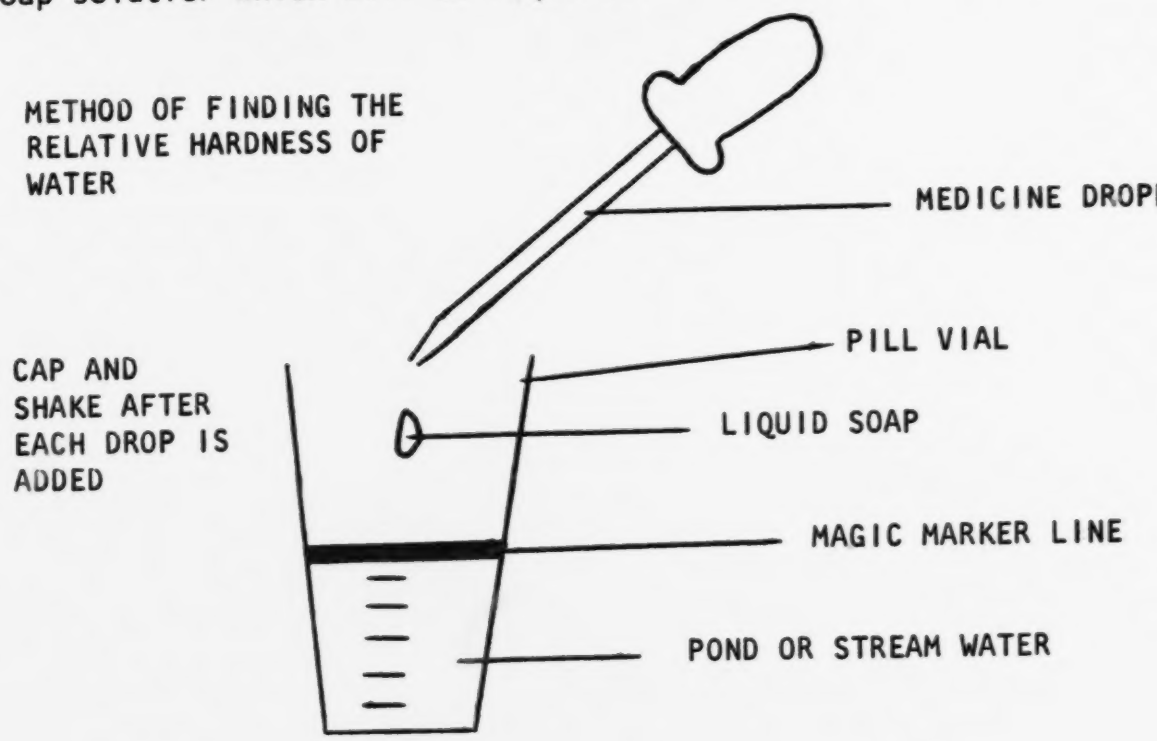
The temperature of the air one, two and three feet above the water could also be recorded. Great care may have to be taken when reading the thermometers as the temperature may vary only half a degree. Even this small difference can help to account for changes in animal or plant life.

20. The Hardness Of The Water:

In order to test how hard or soft the water is a container such as a plastic pill vial and cap and a medicine bottle with a dropper which has been filled with liquid soap could be used.

Use a magic marker to place a mark approximately half way up the side of the pill vial. Fill the vial with water from the stream or pond up to this mark. Add soap solution with the dropper one drop at a time and shake after each drop. Count the number of drops of soap solution required for a lather,which will last for several minutes,to form.

Repeat this test using freshly collected rain water, tap water and distilled water so that some comparison can be made with the hardness of the water from the stream. The harder the water the greater the number of drops of soap solution which will be required.


METHOD OF FINDING THE RELATIVE HARDNESS OF WATER
MEDICINE DROPPER
PILL VIAL
CAP AND SHAKE AFTER EACH DROP IS ADDED
LIQUID SOAP
MAGIC MARKER LINE
POND OR STREAM WATER

21. Changes In Water Level:

If the pupils can return to the stream or pond the following activity might prove interesting. Drive several stakes, at frequent intervals, into the shore line right at the edge of the water. If the stakes were placed soon after breakfast they might be examined just before supper. They could be examined once each day for a week or at other regular intervals.

In any case the pupils should try to find evidence which indicates the highest point to which the water has risen, ie. lines in the mud or on the banks or lines of debris left when the water receded. These could be located and measured quite accurately by working from the transect line.

F. STUDYING THE POND OR STREAM IN WINTER

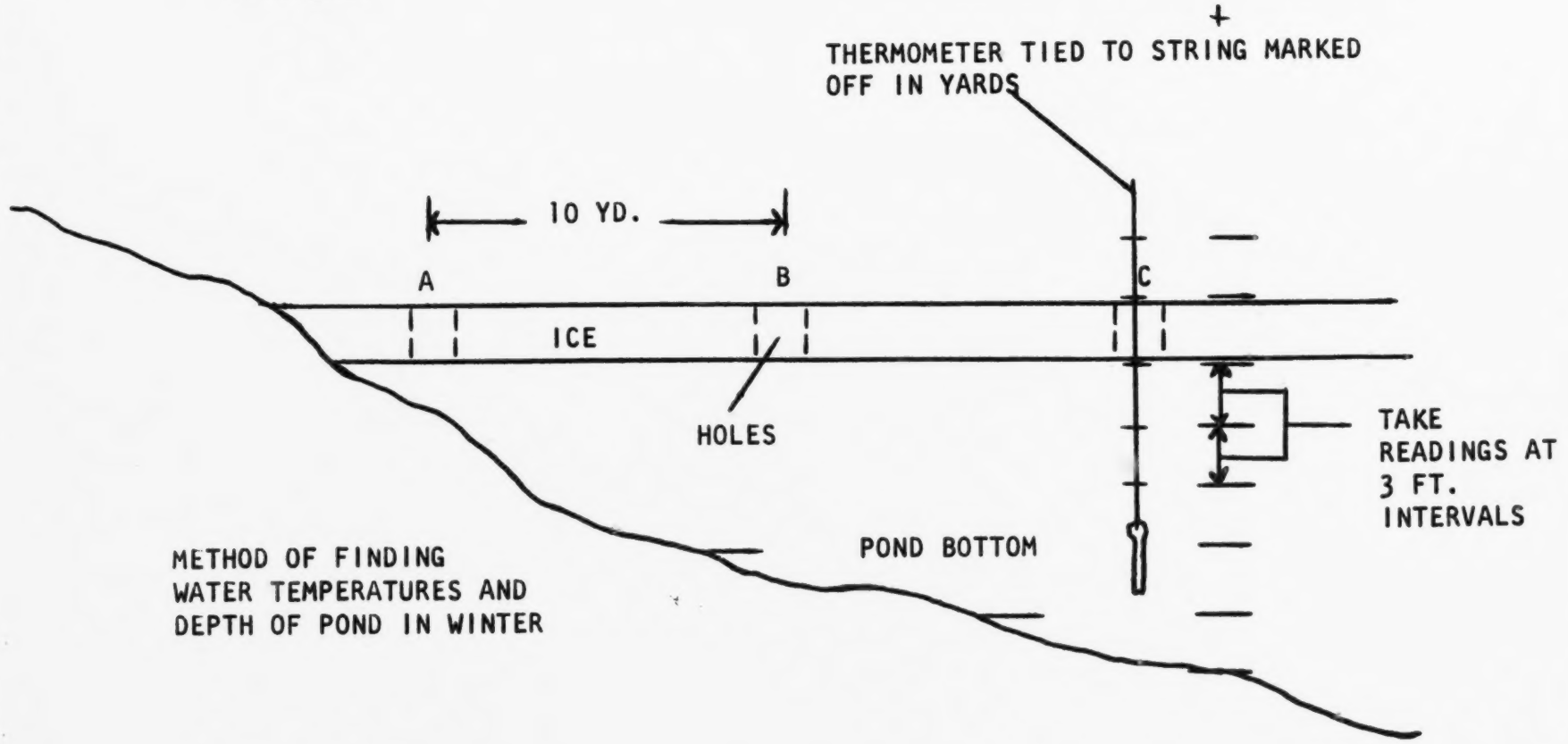
When the ice is thick enough to safely support the weight of the students, holes can be cut, through which several activities can be performed. Use ice augers borrowed from ice fishermen or hard axes to make the required holes.

22. A Temperature Gradient Study:

Use the ice augers to make holes in the ice along a transect line at regular intervals. Because of the ability to walk on the ice a much longer line can be extended out into a pond or lake. Mark a fish line or string at intervals of three feet and tie a thermometer to the end of it so that the thermometer can be lowered into the water. Record the temperature of the water at the surface and at three foot intervals until the bottom of the pond is reached.

A correction factor of about 3°, depending upon the temperature of the air, may have to be added to the thermometer reading to account for changes which occur during the time in which the thermometer is being hauled up and read. If more than one thermometer is being used be sure to compare and standardize the thermometers with a master thermomemter. It is wise to give each hole a number or letter for recording purposes.

Use a meter stick to help record the temperature three feet above the ice. Also, take the temperature of the snow on the ice and the surface of the ice. Several readings should be taken for each position and then averaged.

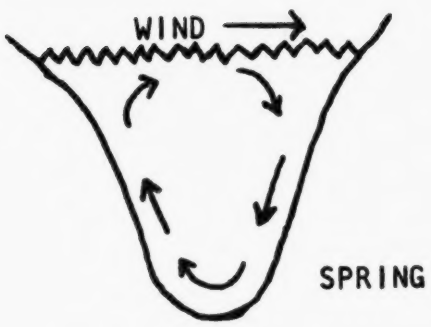


METHOD OF FINDING WATER TEMPERATURES AND DEPTH OF POND IN WINTER

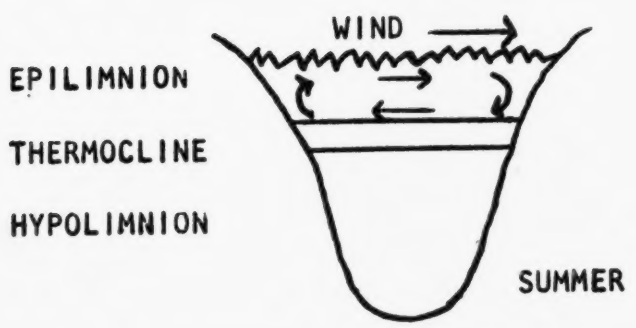
Teacher Background

Seasonal Changes in a Temperature in Ponds and Lakes

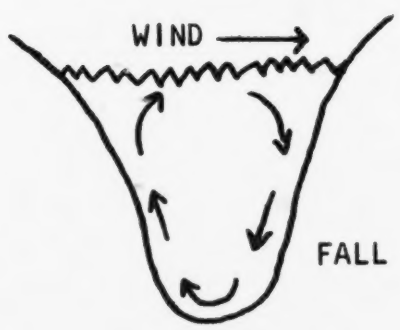
The temperatures at given depths are schematic. The exact temperature in any given pond or lake at various depths will vary somewhat throughout each season, and each pond or lake will exhibit variations from any other at any given time.



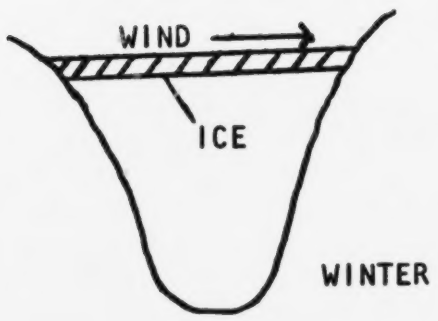
DEPTH FEET	TEMPERATURE • :
0	39
35	39
75	39
110	39
150	39



0	68
35	64
55	45
110	41
150	39



0	39
35	39
75	39
110	39
150	39

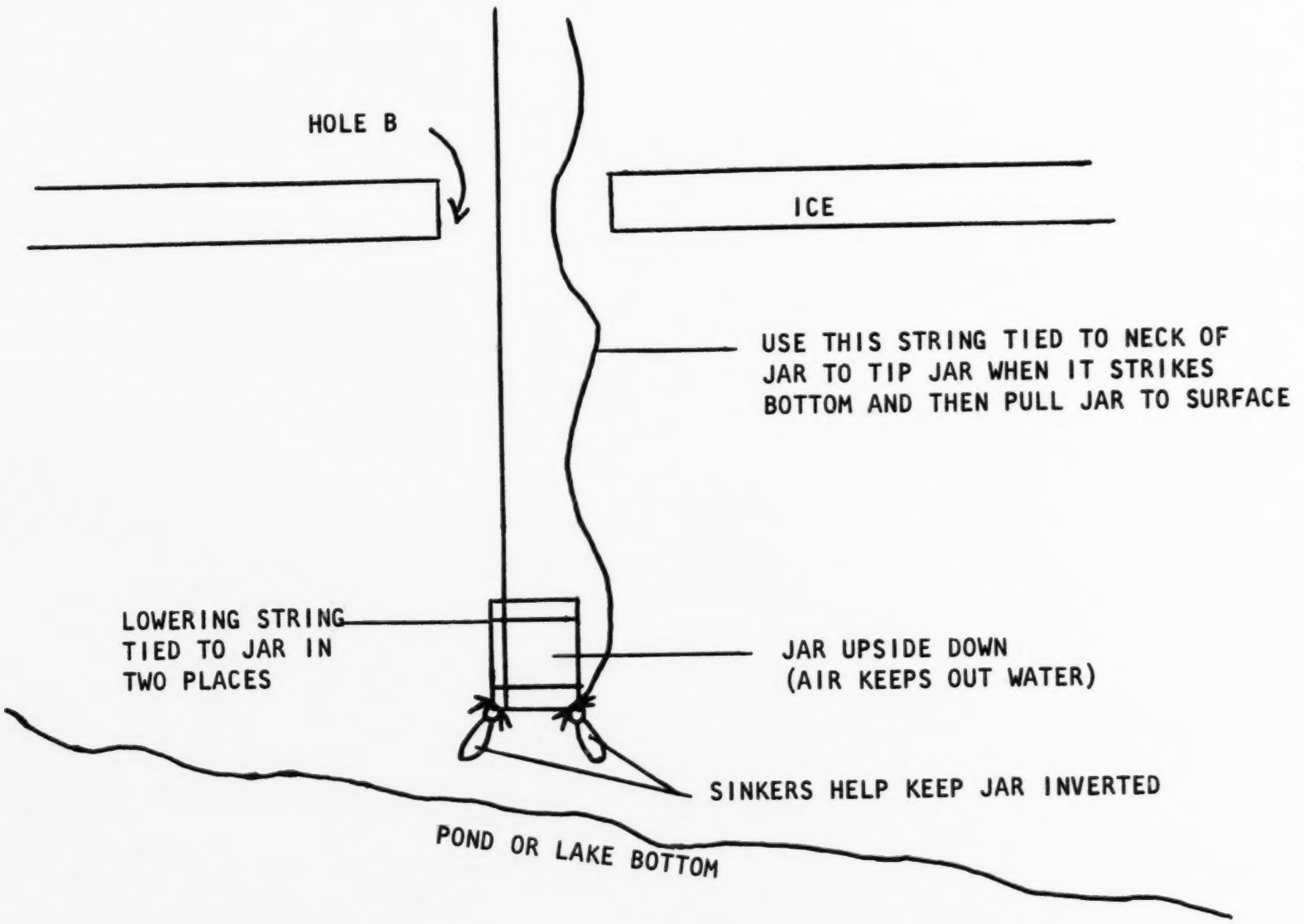


0	32
35	36
75	39
110	39
150	39

NOTE: IF THE POND OR LAKE IS DEEP ENOUGH IT WILL NOT FREEZE TO THE BOTTOM AND THERE IS A POINT WHERE THE TEMPERATURE BECOMES UNIFORM (THE THERMOCLINE). AQUATIC LIFE CAN LIVE BELOW THIS LEVEL.

23. Obtaining Water Samples To Test:

It is very easy to obtain water samples near the ice but it is tricky to collect a sample from the bottom of the pond or lake. The pupils could be given the opportunity to solve this problem. One solution might be as follows:


HOLE B
ICE
USE THIS STRING TIED TO NECK OF JAR TO TIP JAR WHEN IT STRIKES BOTTOM AND THEN PULL JAR TO SURFACE
LOWERING STRING TIED TO JAR IN TWO PLACES
JAR UPSIDE DOWN (AIR KEEPS OUT WATER)
SINKERS HELP KEEP JAR INVERTED
POND OR LAKE BOTTOM

Collect water samples at various depths in pill vials or baby food jars. Label each sample as to depth and location. Upon returning to the classroom examine each sample with a microscope for signs of aquatic life.

24. A Method Of Fish Population Enumeration:

By either lowering a dip net through a hole in the ice or by using a baited hook and line try to catch as many fish as possible. Mark each fish caught by clipping a small notch in its tail with a pair of scissors. (This does not harm the fish and the tail will grow back quickly if the notch is not too large.) Put these marked fish back into the water as soon as possible. Record the number of fish caught and marked.

Revisit the pond the next day and fish again in the same spot. Keep a record of the number of both the marked fish recaptured and the additional unmarked fish which are captured. Return all fish to the water as soon as possible.

Use the data obtained in the following equation:

$$\frac{P \text{ (total population)}}{B \text{ (number of marked and unmarked fish caught in the second sample)}} = \frac{A \text{ (number of fish caught and marked in the first sample}}{C \text{ (number of marked fish in the second sample)}}$$

This equation can be rewritten less difficult. $P = \frac{A \times B}{C}$ to make the calculation

The age of each fish caught could be determined by using either the scale removal or measurement method described in Activity 6.

G. SUMMING UP

A great quantity of data will have been collected when the field work and lab work have been completed. This data should be transcribed into a master sheet so that comparisons can be made and conclusions drawn. Here are some of the hundreds of questions or problems which could be answered by analyzing the data. They are as follows:

Questions

1. Which animals live at which soil depths?
2. Does the location at which a type of animal lives depend upon the temperature?
3. How is the life in fast-moving water different from the life found in slower-moving water?
4. Does the location at which a certain type of animal is found depend upon the amount of moisture in the soil?
5. Which type of animal is the most numerous? Why?
6. Do some animals depend on certain plants and vice versa?
7. What land supplies are available for each type of animal?
8. Which plants grow closest, farthest from the stream? Why?
9. Does the type of plant or animal life found at the bottom of a pond depend upon the type of material in the stream bed?
10. Are the same type of plants found in a stream as in a pond?

11. What is the fastest current speed at which plant life can exist?

12. How is a polluted stream different from a fresh water stream?

13. How does the volume of water in a stream change as the width of the stream changes?

14. Does the type of material at the bottom of a stream depend upon the current speed, the depth of the water or some other factor?

15. How does shade affect the type of life found in a stream?

16. How does the speed of the current change as the stream gets wider?

17. How is the stream different in the spring than in the fall?

18. Does all life cease in the stream in winter?

19. Does a shallow pond freeze to the bottom?

20. How cold is the water at the bottom of a pond?

21. Does the type of plant life found along the banks depend upon the amount of moisture in the soil?

22. What effect has the presence of man had upon the stream?

Each group could present their findings and then these reports could be discussed by the entire class.

Follow-Up Activities

Use the cross sections and plan map to construct a scale model of the section of the stream which was studied. Obtain a large suitable cardboard box. Use blocks of wood to give the correct elevations. Cover the blocks with wire screen and then cover the screen with plaster of paris using a paint brush. Several coats of plaster may be required.

Invite a conservation authority to talk to the class about the methods used in flood control and the restocking of streams.

Prepare posters which show the pond chains found in the stream or pond.

Make a map of the watershed of which the stream studied is but a small part.

Make a booklet which tells all the things learned about the stream or pond studied.

Make a large mural to show and locate all the types of plant and animal life which were found in the pond or stream.

Do research to find out more about one species of animal which was found living in the body of water which was studied.

Study another body of water, a field or a wood lot and compare it with the information obtained from the pond or stream.

H. SOME STREAMS IN THE HAMILTON AREA WHICH COULD BE STUDIED

Getting Permission

If a small stream is within easy walking distance of the school and no main streets are crossed then permission from the Principal is all that is required.

However, if it is necessary to take a bus or travel by car then the Principal may wish to telephone the Superintendent or Inspector to see if a letter to the Board requesting permission is required or if a telephone call is sufficient.

Using Buses

If at all possible try to use regular city bus routes in order to cut costs. Telephone the bus company and notify them of the times, bus stops and destination to be used both in getting to the stream site and returning to the school. Extra buses can often be added to the route to help compensate for the increase in passenger load. Collect the money in advance and buy books of tickets in order to reduce the costs of transportation even further. Try to time your travelling so as to avoid rush hour traffic.

If the body of water selected is outside the city limits telephone the bus company to find the dates, times and routes of buses which will best meet your needs. Often the same stream you wish to visit will cross a bus route at some other point. A great deal of money can be saved by using regular bus routes instead of chartering a bus.

Previewing the Pond or Stream

The wise teacher will carefully inspect the stream or pond site selected in advance of the class visit. Streams change quickly from week to week and drastically from season to season. The recommendations which follow were based upon observations made in early May and so should be checked out carefully before making a decision. Also, new housing developments are planned for many of these areas so that many of the stream sites available at the time of publication may be soon eliminated.

Streams and Ponds

Red Hill Creek

This stream can be studied in these locations all of which can be reached by using city buses and a short walk. This stream is affected greatly by a dump and a sewer at two of these locations:

(a) Stone Church Road just east of Upper James -- The stream is relatively small and pure at this point.

(b) Ottawa Street just south of Limeridge Road -- This stream is affected by the dump to the east of Ottawa Street but is reasonably pure to the west.

(c) This stream can also be studied: In the King's Forest area near the base of Kimberly Drive below the mountain -- A sewer opens into the stream at this point so interesting studies can be made extending both to the north and south of here. There is also a pond in this area.

Chedoke Creek

This very small stream can be studied in two locations:

(a) On the south side of Sanitorium Road just east of Chedoke Hospital.

(b) After this stream flows over the mountain brow it can be reached from the mountain in two ways -- 1. Take the stairs from the foot of Garth Street and travel west along the Bruce Trail or 2. Take the stairs from the foot of Upper Paradise and travel east along the Bruce Trail.

For much of its length where it travels through the city Chedoke Creek is encased in a large concrete sewer pipe but it can be studied from the foot of the mountain to Chedoke Golf Course.

To reach this creek from below the mountain follow the Bruce Trail east from Chedoke Golf Course.

In the Royal Botanical Gardens

(a) In Westdale -- Follow the trail leading downward from the foot of Marion Avenue North. The volume of water in this stream decreases considerably as spring turns to summer.

(b) At the Arboretum Circle -- The Arboretum Circle is located to the west of the old Guelph Line Road on the north side of Coote's Paradise. A bus route services this area on Thursdays only. It is necessary to travel downward on the Old Hickory Trail to reach a small pond and several small streams which feed and leave the pond.

(c) Cherry Hill Gate -- Take the regularly scheduled bus to Aldershot and get off just before reaching the headquarters building for the Royal Botanical Gardens. The trails which lead downward will take you to several streams of various sizes.

(d) Spencer Creek -- By taking the city bus to McMaster University and walking west on Highway 102 a large and sometimes deep creek can be located. This creek runs parallel to the Highway as far as Dundas.

Spencer Creek can also be studied above and below Webster's Falls. There is a regularly scheduled bus service which goes to the C.N.R. Station at Dundas. The part of the stream which flows through Spencer Gorge can easily be reached from there.

Hamilton Regional Conservation Authority

(a) Camp Artiban located in the Dundas Valley has an excellent stream.

I. SOME REFERENCE MATERIALS

Bibliography On Pond And Stream Study -- Education Centre Library

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Clegg, John -- The Observer's Book of Pond Life -- London -- F. Warne & Co. (1956) 1967

Proctor, Elsie -- Nature Study for Primary Schools -- London -- Evans Bros. 1962

Nuffield Junior Science -- Animals & Plants -- London -- Collins, 1967

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Movies -- Available from Audio Visual Department

Birdsof the Marshes

Life Along the Waterways

Life in a Pond

We Explore the Stream

Wonders in a Country Stream

Making a Balanced Aquarium